

In a network embodiment, if a file is changed in a laptop computer while it is disconnected from the network, the invention mirrors that file when the computer is reconnected to the network.

Recovery of mirrored information is fast and easy. In a network embodiment, if Windows is available, the user simply performs a file restore operation that restores the mirror from a server over the network. If Windows is not bootable, the user inserts a recovery diskette and then restores the mirror from the server in either batch or dialog mode using a familiar, Windows-like graphic interface that runs under DOS.

#### C. Continuous Protection

Unlike traditional enterprise storage management systems, the invention performs continuous and real-time mirroring and versioning of data. For example, each time a user saves a file, the invention automatically and immediately mirrors the contents of that file. The unique continuous mirroring and versioning capability protects data more completely than conventional, scheduled mirroring or versioning. Real-time agents are implemented as file system filters below the application level to provide broad continuous support across all applications. Because it is tightly integrated within the file system, the invention is able to accomplish real-time, continuous mirroring and versioning of data.

By mirroring and versioning data on a continuous basis, the invention levels network loading due the random nature of user operations. This allows the invention to provide a high level of protection without significantly impacting network performance.

#### Source Code

Source code for embodiments of some of the components of the invention are attached hereto as Appendices A, B, and C. The attached source code is incorporated by reference as if fully stated here.

#### Illustrative Embodiments

The embodiments of the invention described herein are only considered to be preferred and illustrative of the inventive concept; the scope of the invention is not to be restricted to such embodiments. Various and numerous other arrangements may be devised by one skilled in the art without departing from the spirit and scope of this invention. For example, the disclosed system for virtual memory management can be used with operating platforms other than Windows 95/98 and/or Windows NT.

#### What is claimed:

1. A programmed computer system for managing electronic data storage comprising:
  - means for physically moving electronic data from a source location recognized by a computer operating system and by one or more application software programs to a new destination storage location on the same or other electronic data storage device;
  - means for communicating the new destination storage location of the electronic data to the computer operating system;
  - means for translating the new destination storage location of the electronic data to one or more application software programs so that said application software programs do not detect any change in the location of the electronic data;
  - means for updating said application software programs to request the operating system to access said electronic

data as if said electronic data is located at the source storage location;

means for redirecting the operating system from the source electronic data storage location to the new destination storage location in order to provide the operating system with access to the electronic data at the new destination storage location.

2. The programmed computer system of claim 1 wherein said communicating means, said translating means and said redirecting means includes:

a mirrored directory tree, with one or more entries, wherein each entry identifies the name of a file of said electronic data that has been physically moved to a new destination storage location as it was named when the file was originally stored on a primary storage device, the source file storage location, a new file handle, and a new destination storage location;

a zero length file stored at the source file storage location; computer software to program the computer to interpret for one or more application programs and for the computer operating system each of the entries in said mirrored directory tree.

3. The programmed computer system of claim 1 wherein the moving means further comprises:

means for determining which of a plurality of electronic data storage devices contains the most amount of free space;

means for physically transferring electronic data from a source storage location recognized by a computer operation system and by one or more application software programs to a new destination storage location on the electronic data storage device which has been identified as being the storage device with the most available free space.

4. The programmed computer system of claim 1 wherein said source data storage location is on a read-only electronic data storage device and wherein said new destination storage location is on an electronic data storage device capable of executing read-write instructions.

5. The programmed computer system of claim 1 wherein said physically moved electronic data comprises the data content of an entire file.

6. The programmed computer system of claim 1 wherein said physically moved electronic data comprises the data content of an entire directory.

7. The programmed computer system of claim 1 wherein said physically moved electronic data comprises the data content of an entire physical storage volume of data.

8. A programmed computer system for replacing a plurality of identical copies of a particular set of electronic data with a single complete copy of said data, comprising:

means for identifying a plurality of physical storage locations of identical copies of a particular set of electronic data;

means for storing a zero length file at all but one of the plurality of physical storage locations of the identical copies of a particular set of electronic data;

means for redirecting a computer operating system from the location of a zero length file representing an eliminated duplicate identical copy of said particular set of electronic data to the location of the remaining copy of said particular set of electronic data;

means for the operating system to access the particular set of electronic data physically stored at the location of the remaining copy of the particular set of electronic

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data as if the data was stored at the location of one of the zero length files representing one or more of the eliminated duplicate identical copies.

9. A method for managing electronic data storage comprising the steps:

physically moving one or more bytes of electronic data from a source location recognized by a computer operating system and by one or more application software programs to a new destination storage location on the same or other electronic data storage device;

communicating the new destination storage location of the electronic data to the computer operating system; translating the new destination storage location of the electronic data to one or more application software programs so that said application software programs do not detect any change in the location of the electronic data;

preparing requests by application software programs to the operating system to access said electronic data as if said electronic data is located at the source storage location;

redirecting the operating system from the source electronic data storage location to the new destination storage location in order to provide the operating

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system with access to the electronic data at the new destination storage location.

10. A method for replacing a plurality of identical copies of a particular set of electronic data with a single complete copy of said data, comprising the steps:

identifying a plurality of physical storage locations of identical copies of a particular set of electronic data; storing a zero length file at all but one of the plurality of physical storage locations of the identical copies of a particular set of electronic data;

15 redirecting a computer operating system from the location of a zero length file representing an eliminated duplicate identical copy of said particular set of electronic data to the location of the remaining copy of said particular set of electronic data;

accessing the particular set of electronic data physically stored at the location of the remaining copy of the particular set of electronic data by the operating system as if the data was stored at the location of one of the zero length files representing one or more of the eliminated duplicate identical copies.

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